ORIGINAL ARTICLE

First detection of mobilized colistin resistance *mcr-1* gene in *Escherichia coli* isolated from livestock and sewage in Iran

F. Nikkhahi[1], S. Robatjazi[1], M. Niazadeh[1], A. Javadi[2], G. H. Shahbazi[1], P. Aris[1], S. M. Amin Marashi[1] and N. Emam[3]

1) *Medical Microbiology Research Center,* 2) *Department of Biostatics, Qazvin University of Medical Sciences, Qazvin and* 3) *Department of Microbiology, School of Medicine, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran*

Abstract

Currently, few studies have investigated the mechanisms of resistance to colistin in Iran. The aim of this study was to investigate *mcr*-harbouring *Escherichia coli* dissemination in livestock and sewage in Iran. A total of 115 samples from cows (n = 38), chickens (n = 47) and urban sewage samples (n = 30) were collected. The presence of genes including *mcr1–6* and *ampC* β-lactamase (bla_{MOX}, bla_{CIT}, bla_{DHA}, bla_{ACC}, bla_{EBC}, bla_{FOX}) for colistin-resistant isolates was investigated by multiplex PCR method. Genetic association of colistin-resistant strains was also evaluated by ERIC PCR. Sixty-five isolates were identified as *E. coli*. Meaningless were resistant to colistin. The highest (26.1%) and lowest (3.07%) resistance were shown to ampicillin and meropenem respectively. Among the three colistin-resistant isolates, 2 (66%) were multidrug resistant, with one of them being *mcr-1* positive and the other one positive for DHA *ampC* β-lactamase gene. No *mcr2–6* genes were found. Minimum inhibitory concentration of *mcr*-producing isolate was 4 mg/L by microbroth dilution. This study reports, first the detection of *mcr-1* in *E. coli* from farm animals in Iran, a finding that is indicative of a global distribution of this plasmidic element and threatning the use of colistin as a last resort antibiotic. No clonal relationship was observed between the colistin-resistant *E. coli* isolates by ERIC-PCR. Monitoring the presence of these strains in animal sources help as to controlling the spread of resistance genes from animal to human is vital.

Keywords: Colistin resistance, Escherichia coli, livestock, *mcr-1*
Original Submission: 13 October 2020; **Revised Submission:** 17 February 2021; **Accepted:** 4 March 2021
Article published online: 18 March 2021

Corresponding author: F. Nikkhahi, Medical Microbiology Research Center, Qazvin University of Medical Sciences, PO Box 34199, 15315, Qazvin, Iran.
E-mail: Farhadnikkhahi@gmail.com

Introduction

The increasing prevalence of antibiotic resistance is one of the global health threats in the 21st century [1]. *Escherichia coli* (*E. coli*) is recognized as one of the major causes of nosocomial infections [1,2], acting as a reservoir of antimicrobial resistance genes (AMRs). Polymyxins, including polymyxin B and colistin, are the latest agents for the treatment of infections related to multidrug resistant gram negative bacteria (MDR-GNB) [2]. These agents primarily bind to the bacterial surface and reduce its integrity, increase its permeability and ultimately lead to the death of bacteria [3]. However, the use of colistin has been limited for treatment considering its nephrotoxic and neurotoxic effects [4]. By 2015, mutations in two-component regulatory systems, including *PmrB, PmrA, PhoP, PhoQ* and *MgrB,* were the only resistance mechanisms to colistin [5]. The mobilized colistin resistance (*mcr*) gene, conferring plasmid-mediated resistance to colistin, was first detected in China [2,3]. So far, ten different plasmid-mediated colistin resistance genes have been reported in the *Enterobacteriaceae* family. *E. coli* studies have particularly demonstrated that poultry and livestock can potentially carry isolates containing *mcr* genes; therefore, they can transfer drug-resistant bacteria to humans. Colistin is widely used in veterinary medicine to treat gastroenteritis in food-producing animals, especially pigs and poultry [6].

Despite the increasing prevalence of *mcr* plasmid–mediated colistin resistance among clinical isolates and the risk of

https://doi.org/10.1016/j.nmni.2021.100862